Ramanujan—the Man Behind the Mathematician

Today, his work is helping unravel knots in areas ranging from computer science to cancer research and polymer chemistry. Remembering the genius on his 120th birth anniversary

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GODFREY HARDY was annoyed. The renowned Cambridge mathematician had just received a letter from a strange Indian named Srinivasa Ramanujan asking him for his opinion of 120 mathematical theorems that Ramanujan claimed he'd discovered. Hardy regularly got letters from cranks claiming to have solved all kinds of problems, and this one seemed no different. He glanced at it with distaste.

Many of the theorems made no sense. Of the others, one or two were already well-known. Ramanujan must be some kind of fraud, Hardy decided, and tossed the letter aside.

But all that day the letter kept nagging Hardy. Might there *be something in those wild-looking theorems?* That evening he summoned fellow mathematician J.E. Littlewood, and the two set out to assess the Indian's worth.

By midnight they knew the truth. Srinivasa Ramanujan was a genius. As Hardy explained later, many of those fantastic theorems had to be true because "no one would have had the imagination to invent them."

That incident in January 1913 was a turning-point in the history of mathematics. At the time, Ramanujan was an obscure Madras Port Trust clerk. A little more than a year later, he was at Cambridge University, and beginning to be recognized as one of the most amazing mathematicians the

Mathematicians describe Ramanujan's results as elegant and beautiful world has known. Though he died in 1920, much of his work was so far in advance of his time that only in recent years is it beginning to be properly understood. Indeed, his results are helping solve today's problems in computer science and physics, in cancer research and polymer chemistry— problems that he'd had no inkling of. For Indians, moreover, Ramanujan has a special significance. "Until Ramanujan," said Dr S. S. Rangachari, formerly of the School of Mathematics at the Tata Institute of Fundamental Research, Mumbai, "India had not produced a first-rate mathematician for hundreds of years. Ramanujan inspired many Indians to adopt mathematics as a

career. He gave us all a feeling of self-confidence and since his time we've had mathematicians of international caliber."

Much of Srinivasa Ramanujan's work is in number theory, a branch of mathematics that deals with the subtle laws and relationships that govern numbers. Mathematicians describe his results as "elegant" and "beautiful" but they are much too complex to be appreciated by the layman. His life, though, is a different matter. Full of drama and pathos, it is one of the great romantic stories of mathematics, a poignant reminder that genius can surface and flourish in the most unpromising circumstances.

Born on December 22, 1887, Ramanujan came from a family of poor but high caste Aiyangar Brahmins. His father was an ill-paid accountant of a Kumbakonam, TN, and cloth merchant. Like many geniuses, Ramanujan was the eldest child: in fact, his parents had no children for several years after marriage and, so Ramanujan's mother claimed, it was only because the family had prayed to goddess Namagiri Lakshmi that Ramanujan was born.

Ramanujan's interest in mathematics became evident very early. As a child he was curious about the distance and shape of the stars and calculated the length of the Equator all by himself. His teachers, recognizing his gifts, gave him the job of preparing the school's time-tables.

His mother Komalattammal also got him interested in astrology and palmistry and throughout his life Ramanujan, like another great mathematician, Isaac Newton, remained an enthusiastic devotee of the occult.

At the age of 15, Ramanujan borrowed an advanced mathematics textbook from the local college library. It wasn't a good book—it was only a catalogue of results without comprehensive proofs—but it captivated Ramanujan and stimulated him to start his own creative work.

IN 1903, RAMANUJAN got a first-class in the school-leaving exam and won a college scholarship. But much too wrapped up in mathematics to study any other subject, he was an academic disaster. He took the college exam twice and failed both times.

These were Ramanujan's grimmest years. By now, his parents had two more sons and the family's finances were more precarious than ever. When his parents, upset by his failure in college, insisted that he earn some money, he started giving maths tuitions. But he was a poor teacher—he talked above the heads of the students and they soon stopped coming to him.

Ramanujan's sole consolation during this period was his own mathematics. Nobody understood what he was doing: he had progressed

far beyond any textbook available at Kumbakonam. But his head teemed with mathematical ideas and he worked on them feverishly, sometimes hiding under the cot to avoid his parents' wrath. The goddess Namagiri, he told friends, was inspiring him.

Hoping it would bring him down to earth, Ramanujan's parents got him married in 1909. Since Janakiammal, Ramanujan's bride, was just ten, she came only occasionally to Kumbakonam. Indeed, in their 11 years of marriage, Janaki and Ramanujan spent less than three years together. (She died in 1994, and outlived Ramanujam by 74 years.)

Desperate to get a job, Ramanujan turned for help to people interested in mathematics. Inspired by what he saw in Ramanujan's notebooks (though he couldn't understand much of it), R. Ramchandra Rao, collector of Nellore and later president of the Indian Mathematical Society, offered to pay Ramanujan a monthly stipend. Ramanujan was free to simply dream on about maths.

Although he accepted the offer, Ramanujan felt humiliated at having to live on charity and kept looking for a job. Finally, in March 1912, thanks to a manager who was a keen amateur mathematician, he got a clerical post at the Madras Port Trust. But it didn't pay much —only Rs25 a month—and unable to buy all the paper he needed, Ramanujan did his equations on discarded Port Trust wrapping paper. Despite his poverty, this was a productive period for Ramanujan. He was so intent on his work that he often didn't stop, even to eat—Janaki and his mother fed him at mealtimes so that he could continue writing.

By now, some of Ramanujan's work had been published in the *Journal of the Indian Mathematical Society* and he'd become a familiar figure in Madras [Chennai] mathematical circles. A short, plump man with a big head and bright, burning eyes, his long hair combed and tucked according to Brahmin custom, he inspired everyone he met. But at the time India was a mathematical backwater; there was no one in the country who could assess Ramanujan's work or provide him the necessary intellectual stimulation. Friends urged him to send his work to England, then one of the centers of world mathematics.

Thrice Ramanujan wrote to eminent mathematicians. All three times he received non-committal replies.

Then, on January 16, 1913, he wrote to Hardy. That letter was to change Ramanujan's life forever and lead to an extraordinary intellectual partnership. As soon as he realized Ramanujan's worth, Hardy urged him to come and work in Cambridge. Ramanujan's mother, however, was dead against the idea. For orthodox Hindus, crossing the seas meant losing caste and risking social ostracism when they returned. Moreover, in May 1913, Madras University awarded Ramanujan a two-year research scholarship worth Rs75 a

month. For the first time in his life Ramanujan was free to think of mathematics all day long without being worried about making ends meet.

IRONICALLY, IT WAS Ramanujan's mother who broke the impasse. She announced one morning that she'd had a dream in which she'd seen her son seated in a large room surrounded by Europeans. The goddess Namagiri had then appeared and told her not to prevent her first born from fulfilling his destiny.

Ramanujan arrived at Trinity College, Cambridge, in April 1914, a few months before World War I began. There is no record of his first meeting with Hardy. But no two men could be more different. Hardy, then 37, was lean and handsome, passionately fond of cricket, a skeptic and rationalist who, as one of his friends put it, "considered God his personal enemy." Chubby Ramanujan, on the other hand had no interest in sports and was a devout Hindu who saw the divine everywhere. "An equation," he once said, "has no meaning unless it expresses a thought of God."

Professor Hardy of Cambridge was Ramanujan's mentor. "Obviously," Hardy said later, "I learnt from him much more than he learnt from me."

There was a great difference in their approach to mathematics, too. Unlike Hardy, Ramanujan thought intuitively—he didn't bother much about rigorously proving his results. Moreover, because he was largely self-taught, he knew nothing about many vitally important areas of modern mathematics. Hardy, therefore, had to bring him up-to-date in these matters, but in a way that would not destroy Ramanujan's self-confidence nor dry up his inspiration. "I succeeded," Hardy said later, "though obviously I learnt from him much more than he learnt from me." And during Ramanujan's five years in England, Hardy and he collaborated on some of the finest mathematical papers ever written.

Ramanujan blossomed at Cambridge—at one time, Hardy said "he was showing me half a dozen new theorems a day"—but he never really liked living in England. He hated the cold, damp weather, so different from sunny Madras. Indeed, his first few nights at Cambridge were most uncomfortable. Only after another Indian student showed him that English beds are made with blankets tucked in a bed sheet did Ramanujan finally get a good night's sleep. Until then, he'd been lying on top of the blankets, shivering in an overcoat and shawl.

FOOD, TOO, WAS a problem. A strict vegetarian, Ramanujan had to be very careful of what he ate and usually cooked in his own room. Once, at a London boarding-house, Ramanujan drank some Ovaltine. Shortly afterwards, he glanced at the container and was horrified to find that the beverage contained egg. A few hours later, he was caught in an air raid, and though he wasn't hurt, was convinced that this was punishment from God.

Apart from such unintentional lapses, Ramanujan lived like an orthodox Hindu during his years in England. He had a *puja* room in his college lodgings and worshipped regularly. Though he always dressed in European clothes when he went out, in his rooms he wore his caste mark and dhoti and walked around barefoot. He was popular among the Indians at Cambridge and occasionally invited friends over for a meal. A good host, he made delicious vegetarian food, and entertained his guests with not-too-difficult mathematical puzzles.

Ramanujan had three extremely fruitful years at Cambridge. Then in the spring of 1917, he fell ill. Tuberculosis was suspected, but it's more likely that he was suffering from a severe vitamin deficiency. Doctors felt that his health might improve if he returned home, but because of the war, it was too dangerous to travel. For the next couple of years Ramanujan was in and out of hospital vainly seeking a cure. He grew steadily weaker, but his mathematical talents were unaffected. Once while visiting Ramanujan in a London nursing home, Hardy started chatting with him about the number of the taxi that he'd come in.

"It was 1729," Hardy said. "It seemed to me rather a dull number."

* 1729 = (12 x 12 x 12) + (1 x 1 x 1) as well **as** (9 x 9 x 9) + (10 x 10 x 10)

Ramanujan protested. "No, Hardy, no Hardy!" he cried. "It is a very interesting number expressible as the sum of two cubes in two different ways."

Apart from his illness, another matter was tormenting Ramanujan at this time. It had become clear to him that a good deal of the work he'd done in India was a rediscovery of what European mathematicians had already established. So many precious years wasted. All that he'd accomplished in England could not make up that loss. Deeply depressed and lonely, Ramanujan threw himself in front of a train in the London Underground. Luckily, the train stopped in time. Ramanujan was arrested, but Hardy persuaded the police not to press charges.

IT WAS SOON afterwards that Ramanujan received two unique awards. He was elected to the Royal Society—the second Indian to be so honored. And a few months later, he became the first Indian to be elected a Fellow of Trinity College, Cambridge.

Ramanujan rallied briefly towards the end of 1918, and in February 1919, by now gaunt and emaciated, he set sail for home.

He received a hero's welcome. But, alas, the warm climate and Janaki's cooking failed to improve his health. He continued to work on his mathematics and write to Hardy, but it was clear that the end was near. Early in the morning of April 26, 1920, he passed away. Sadly, he had to be cremated without any rites—no priest would perform them because he had broken caste taboos.

At his death, Ramanujan left behind thousands of unpublished theorems in several notebooks and scraps of paper. This legacy has fascinated mathematicians ever since. The eminent Hungarian mathematician George Polya once borrowed Ramanujan's notebooks from Hardy, then returned them a couple of days later almost in a state of panic. Ramanujan's formulae, Polya said, were so fascinating that he kept trying to prove them and in the process was neglecting his own work. Other mathematicians have spent years doing just this and new sub-disciplines in mathematics have grown up around their efforts.

Indeed, more than eight decades after Ramanujan's death, many of his mathematical insights still have relevance to today's complex problems in a growing number of disciplines. "It's a shame Ramanujan wasn't born a hundred years later," said Professor Richard Askey of the University of Wisconsin, Madison, USA. "It would be marvellous to have somebody with his intuition to help us."

Three Plays and a Book. Films Too...

Ramanujan has been the subject of two recent **US** plays, *Partition* and *a First Class Man;* and, in London, *A Disappearing Number.* All of them imaginatively explore Ramanujan's genius and his relationship with Hardy. In *Partition* (the title is a reference to Partition theory in mathematics), the goddess Namagiri (scene, left) decides she doesn't have enough to do in India and goes to England with Ramanujan. Her presence at Trinity College, Cambridge is indeed fanciful.

The biographical book *The Man Who Knew Infinity* by Robert Kanigel (1991) is part adventure, part thriller. The book is to be made into a movie. Plans for yet another movie, co-directed by Stephen Fry and Dev Benegal, were also announced last year.